Casting Emission Reduction Program

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ASAM IVI Evaluation

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Association for Standardization of Automation Systems (ASAM) Interchangeable Virtual Instruments (IVI) Evaluation Progress Report

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TECHNIKON
ENVIRONMENTAL DEVELOPMENT CENTER™

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A. Summary

This report contains a summary of the progress to date on the ASAM/IVI evaluation task.

B. Background

Instrument driver technology has become an efficient and reliable method for communicating with instruments for industrial and testing purposes. ASAM is a standards organization within the automotive industry, which is promoting standards for instrument interfaces and other portions of a manufacturing development and test system. The IVI Foundation is a standards organization, which is working on standardizing instrument interfaces within the test and measurement community. There is some overlap in the work of the ASAM and IVI organizations in the area of standardized instrument interfaces. This task was instituted to evaluate the relationship of ASAM and IVI and to determine if there was a potential for cooperation between the two organizations.

C. Progress to Date

Technikon, LLC joined both the ASAM standards organization and the IVI Foundation, attended meetings, and evaluated the specifications from both organizations. As a result of this evaluation, a report was prepared which summarized the relationship between the two organizations and their specifications. The report presents an approach to potential cooperation between the two organizations, and for developing a prototype implementation that would demonstrate an interface between the two systems. The ASAM/IVI Evaluation appears in Appendix 1.

Currently, the ASAM organization has specifications that are in a fully developed state in the area of instrument interfaces. This specification is called the Generic Device Interface (GDI) specification, and it is currently in version 4.2. In addition to the GDI specification, ASAM is working on specifications for specific instrument interfaces, which are called companion standards. Current work includes companion standards for an emission bench, multi-channel data acquisition system, and others.

The IVI Foundation has not completed work on the full version of its initial set of specifications. It has completed work on a set of device interface specifications for several devices, although these specifications are likely to change once the final version of the system specifications are complete. The work that was previously done, and the device drivers that are currently available, are for a "C" language interface. The interface that would be most useful for an ASAM-IVI cooperation project would be the next generation specification, which is a Component Object Model (COM) interface. Work on the COM interface is still ongoing, and example drivers are not yet available. It is expected that the first set of working COM drivers will be available sometime in May 2001. The IVI system specifications will also be available in that same time frame or possibly a little later.

The attached evaluation outlines an approach for developing a prototype implementation of an ASAM/IVI driver. In order to perform this prototype, it would be necessary to use the IVI COM driver sample implementations and specifications as a starting point. Once these specifications and sample drivers are available, which could be within the next 1-3 months, a prototype implementation could be undertaken. This implementation should demonstrate the feasibility of taking an IVI driver, which has been developed for a test and measurement instrument such as an oscilloscope or logic analyzer, and plugging that driver and instrument in to an ASAM system with no changes, or with minimal changes.

D. Summary

The ASAM-IVI Evaluation in Appendix 1 presents an analysis of the relationship of the ASAM and IVI organizations, the work the organizations are performing, and some avenues for cooperation between the two organizations. It also presents an approach for developing a prototype implementation to prove the feasibility of cooperation between the two organizations. If this were successful, it would reduce the cost for instrument vendors, system integrators, and end users to implement a system involving components from both ASAM and IVI domains.

Appendix A

ASAM-IVI Evaluation

IVI/ASAM Evaluation

A. Introduction

Instrument driver technology has become an efficient and reliable method for communicating with instruments. IVI emerged within the test and measurement industry to standardize this technology. In parallel, ASAM emerged within the automotive industry to address the same issue. The purpose of this paper is to analyze the cooperation benefits to both organizations and to propose a method of interfacing between IVI and ASAM-GDI.

B. Description of ASAM

The Association for Standardization of Automation and Measuring Systems (ASAM) is an International standards organization that began in 1991 with a group of German automobile companies who wanted to standardize the architecture of their automotive test systems. ASAM soon expanded across Europe, becoming a European organization and incorporating in 1998. The joining of the major U.S. automotive companies in the last year has made ASAM a truly international organization. It now has 87 members including all major auto manufacturers and many automotive equipment vendors.

ASAM has created a standard architecture comprised of a number of components. These components include various software interfaces at different levels that fit into the overall ASAM architecture; standard data interfaces (Open Data Systems - ODS); Measurement, Calibration and Diagnostics (MCD) device interfaces; and other components including the one of primary interest to this discussion – Generic Device Interface (GDI). ASAM-GDI provides a standardized and interchangeable way for an application program to communicate with "intelligent devices" including various test system instruments.

C. Description of IVI

The Interchangeable Virtual Instruments (IVI) Foundation is a standards organization, which began in 1998 with a goal of providing a standard way to write instrument device drivers in order to provide interchangeability between devices without affecting the application (test system) software. IVI currently has 50+ members including users, integrators and vendors. IVI has created an architecture, which provides a standard IVI driver interface for instruments of the same class like DMMs or Scopes. Using the IVI standard API allows interchangeability of instruments without changing user/application software.

D. Potential Cooperation between IVI and ASAM

The IVI architecture includes an IVI driver providing a standard way to interface to instruments. This is similar to an ASAM-GDI driver, which also defines a standard way to interface to instruments. One way that IVI and ASAM may work together is to find a way to allow an instrument with an IVI driver to plug into an ASAM system. It may also be useful to allow an ASAM instrument driver to plug into an IVI system, but this paper will not address that aspect.

Interfacing between IVI and ASAM-GDI would allow an IVI instrument (defined as an instrument that includes a standard IVI driver) to be used in an ASAM system without the necessity of writing an ASAM driver for the instrument. Ideally, this interface would be totally automated so that the IVI instrument/driver could be plugged in and used without the need to modify any data files or write any software. It may require the use of some tool(s) to convert an IVI instrument description

(Interface Definition Language (IDL) file) to an ASAM instrument description Interface Definition Language (IDL) Device Capability Description (DCD) file.

E. Advantages of Cooperation

There are numerous advantages to both IVI and ASAM members if this approach is successful. It is envisioned that both the IVI and ASAM organizations would continue to exist in their present form, but they would essentially obtain the advantages of a great increase in membership without any (or minimal) additional increase in effort. Some of those advantages are shown below:

- IVI instrument manufacturers gain broader market potential since all ASAM users would be able to use IVI instruments in their ASAM systems.
- IVI users would benefit from additional ASAM standards (e.g. ASAM database standards).
- IVI users would benefit from the ASAM certification program for ASAM drivers.
- ASAM users gain easy access to IVI instruments without requiring a new driver to be written.

Additional benefits to both IVI and ASAM members could also occur because of cooperation between the two organizations, independent of the specific architecture chosen. Some of these include:

- IVI members would benefit from ASAM's standard certification approach.
- Both organizations would benefit from the publicity surrounding the cooperative efforts.
- IVI would benefit from ASAM's other architectural components besides drivers, including a standard database/data interchange architecture (Open Data Systems).

F. A Possible Architecture for IVI/ASAM Interface

The relevant part of the Standard ASAM-GDI architecture is shown in Figure 1. The features of this architecture that are of primary interest are the coordinator, the platform adapter, the ASAM driver, and the DCD file. The ASAM coordinator provides coordination between the application and multiple drivers to provide device independence. The platform adapter allows the device driver to run on multiple platforms without (source code) modifications, thus providing platform independence. The ASAM device driver provides the same functionality as the IVI driver. The DCD file is a description of the device written in Interface Definition Language (IDL) format.

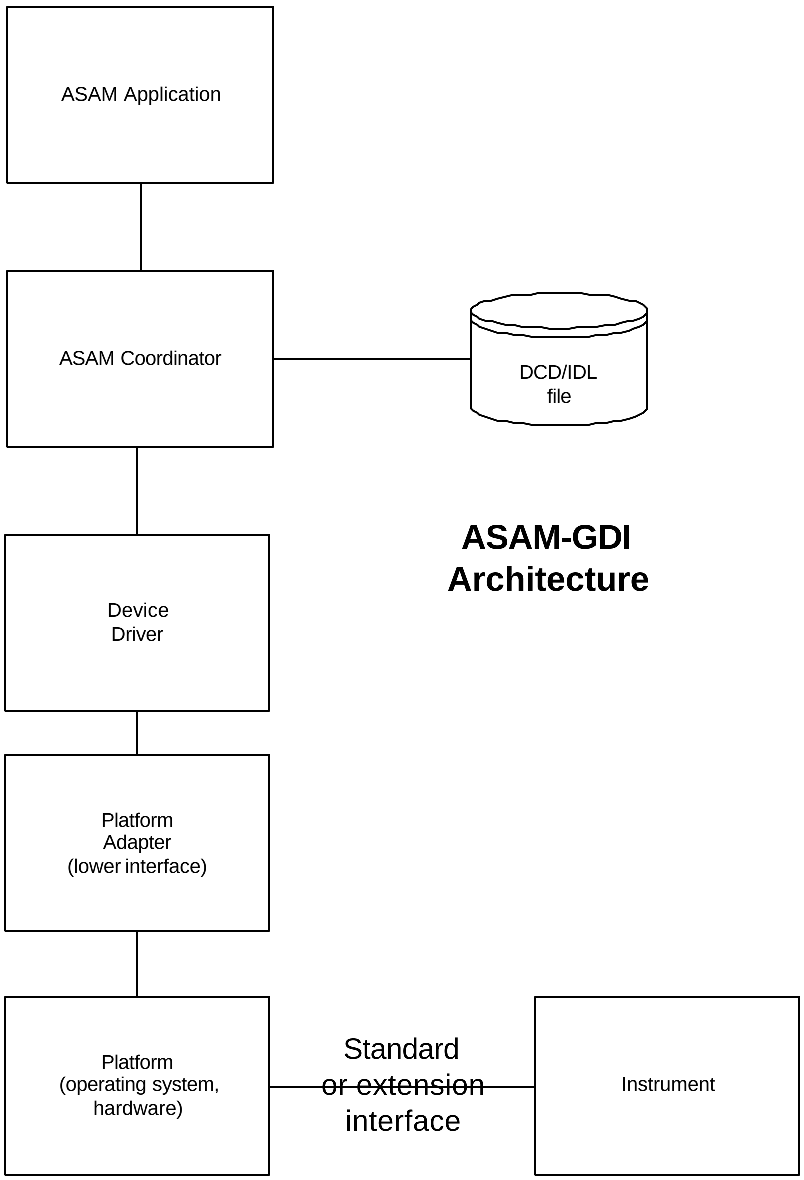

Figure 1 – Standard ASAM GDI Architecture

A simplified drawing of the IVI/COM Architecture is shown in Figure 2. It shows the IVI application, IDL file, COM interface, and IVI driver.

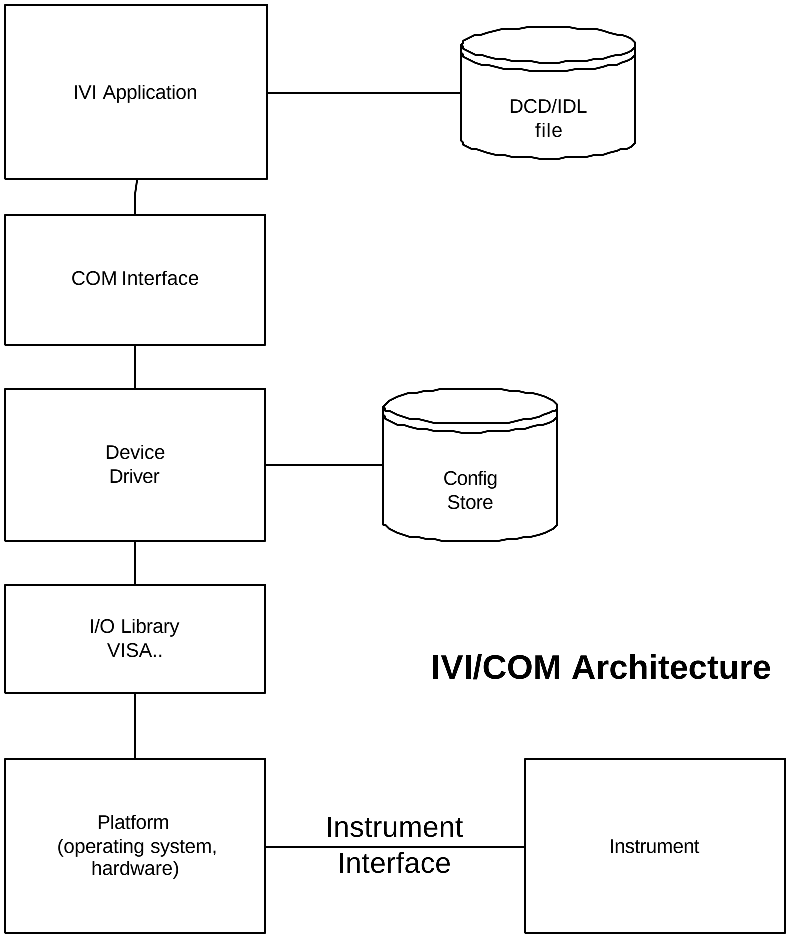

Figure 2 – IVI/COM Architecture

There are multiple ways that an IVI driver could be made to “plug in” to the ASAM architecture. One possibility is shown in Figure 3.

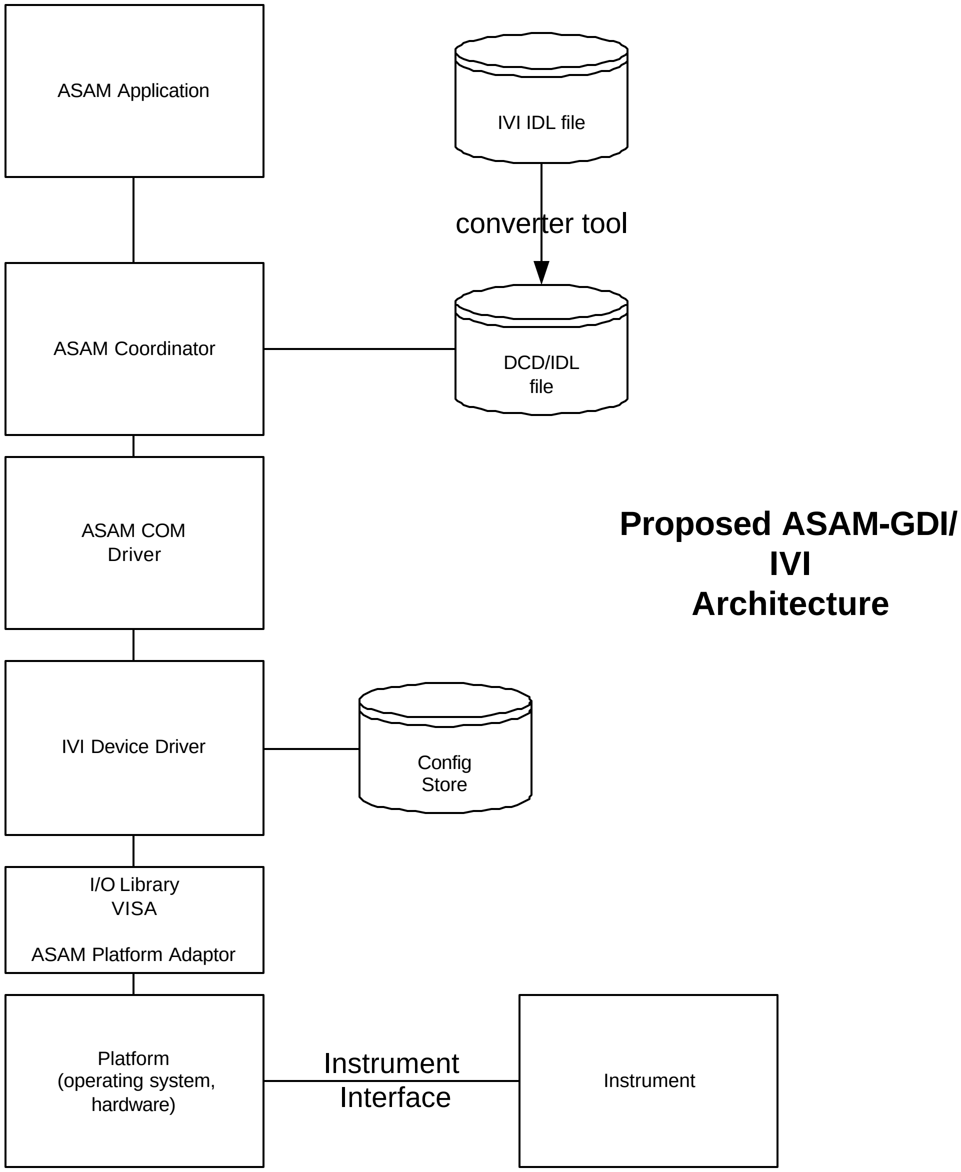

Figure 3 – Proposed Combined ASAM GDI/IVI Architecture

There are two basic features of this proposed architecture that provide the interfacing of ASAM applications to IVI instruments. The first feature is the mapping of the device description provided in the IVI IDL file to an ASAM device description in an ASAM DCD/IDL file. This mapping would take place offline when the device was installed, using a converter tool. The second feature is the mapping of the ASAM application-to-device-driver calls into the corresponding IVI/COM calls. This mapping would take place at run time as the calls are made.

Both IVI and ASAM depend on an IDL file – ASAM uses Corba IDL and IVI uses Microsoft IDL. Although there are significant differences between the two, they are both based on the same standard, and they both provide the same basic view of an instrument. The IDL file defines the instrument driver and includes interfaces with methods and attributes/properties for the various instrument capabilities. The hearts of the IDL files are very similar, with the interface description of instrument capabilities. Much of the peripheral information is different. However, it should be possible to map an IDL description of an IVI instrument into an IDL/DCD description compatible with ASAM-GDI. This would provide the instrument interface definition in an ASAM compatible format. This mapping could be done manually, or (ideally) by an automated method.

The proposed architecture would allow the ASAM application/coordinator to use those interface methods and attributes to make calls to an IVI driver. The new IVI architecture is based on COM (Component Object Model), and provides a COM- wrapper around the actual instrument driver. So the problem boils down to providing a way for an ASAM program to make calls to a COM component. ASAM has provided a similar capability to COM with their GDI-API. This provides a platform (operating system) independent method to make calls to drivers using run-time linking (e.g., Dynamic Link Library (DLL)). One of the primary methods for doing this is to provide an Execute() routine which allows the ASAM program to execute an arbitrary routine in the driver, using an ID that is defined in the IDL/DCD file. This is similar to the COM mechanism of IDispatch, which allows calls to be made to COM components using an ID that is defined in the IDL file.

It should be possible to map an ASAM Execute() call, for an DCD/IDL-defined routine, to a COM call to the COM IDL-defined routine. This mapping software could possibly be part of a special ASAM device driver, which would be the ASAM COM driver. This would allow an ASAM program (application/coordinator) to access the DCD/IDL file (which is based on an IVI IDL file for the IVI driver) to determine the instrument capabilities, make a standard ASAM call to an instrument capability (method/attribute), and have that call mapped into a COM call to the IVI instrument driver. This mechanism would be platform dependent, since it relies on COM.

G. Areas for Further Investigation

A prototype should be constructed to demonstrate that an ASAM application could actually call an IVI driver. This should be done by taking an existing IVI driver, based on the new IVI (COM) architecture, together with its IDL file. That IVI driver with its corresponding IVI IDL file should be used to generate an ASAM DCD/IDL file, and software should be written to map the calls from ASAM-GDI to COM. In the process of doing this, several things should be considered as described below.

1) IDL mapping: Although the basic IDL definition is very similar, there are significant extensions, particularly on the Microsoft IDL side. The MIDL file includes several files with things such as type definitions, and it is possible that some of these could be difficult to map. Some lost capability may occur when mapping between the two, and this should be noted. The heart of the IDL files on both sides is the description of the instrument interfaces, including functions (methods) and attributes (properties). These descriptions are very similar for the two systems. However, the problems may lie in peripheral features of the IDL files that may be difficult to map automatically, or which do not map well at all.

2) Second, the GDI to COM calls: This should be done as generically as possible. Ideally, it would allow any COM component to be plugged into the ASAM interface, as long as a suitable DCD/IDL file was provided. There may be some things, which are difficult to map, such as (possibly) events, etc.

H. Problems and Limitations of the Proposed Architecture

One of the inherent features of ASAM is its platform independence. This means that ASAM applications work on a variety of platforms (including different operating system and different hardware architectures). This makes it difficult to use the same IVI drivers, since the IVI driver depends on the Microsoft COM standard. This platform independence is a major ASAM feature that is needed by many of the ASAM users who have systems running on different platforms (e.g., Unix). The platform independence is implemented using the ASAM Platform Adapter, which must be written for each platform, and which provides a standard interface to the ASAM application and to the ASAM driver. The platform adapter provides driver-level functions such as io-open() and io-read(), in a platform independent way, and maps those calls to whatever operating system it is running on. It is not clear whether this platform independence could be maintained when using an IVI driver that is basically a COM component.

There are possible ways that some platform independence could be provided using third-party COM implementations that have been written for Unix and other systems, but it is not known how successful this would be. It might also be possible to provide a platform adapter extension that makes remote calls to a COM component interface that resided on a Windows platform.

At the time of the completion of this study, the IVI Architecture is still undergoing revision. The IVI interface, which is of interest, is the COM interface, and there is currently not a completed COM interface specification and example driver that could be used as the basis for a prototype. It is expected that in the near future there will be a more complete IVI COM specification, and example IVI COM drivers should also be available. Once those items are ready, further investigation and/or a prototype implementation could be undertaken.

I. Summary and Conclusions

This brief paper has presented a discussion of the ASAM-GDI architecture and the IVI/COM architecture, and how they might be made to work together. The combined ASAM/IVI architecture that was presented is one approach; however, other approaches are possible. Some of the benefits and limitations to this approach were discussed.

This paper can serve as the framework for further investigation and discussion. Because the IVI COM interface specification is not yet complete, a prototype implementation would be difficult at this time. However, it is expected that the IVI COM interface specification and example drivers will be available by mid-2001. It is recommended that when the IVI COM implementation is ready a prototype of the combined ASAM/IVI architecture be undertaken to demonstrate the feasibility of the approach.